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Advanced Wireless Sensor Nodes - MSFC 2016

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The Chosen ZigBee Module

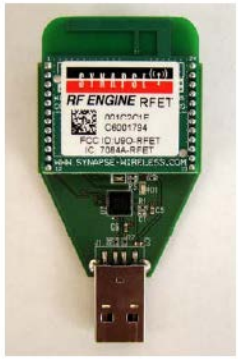
- The Synapse RF200

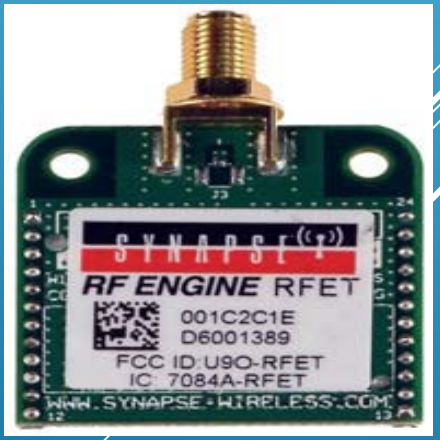
Modules, contain a complete A/D, Microcontroller ,802.15.4 radio and Mesh Protocol Software Stack.

- Capable of uploading new software into each module over the air (OTA).

RF200P81 / SM200 Synapse 2.4 GHZ IEEE 802.15.4/ZIGBEE® RF TRANSCEIVER
RX: 22.5 mA (@ 3.3 V)
TX: 22.5 mA (@ 3.3 V)
33.86mm x 33.86mm
20 GPIO and up to 7 A/D inputs

SN132 SNAPstick USB module





SM200 Module Block Diagram

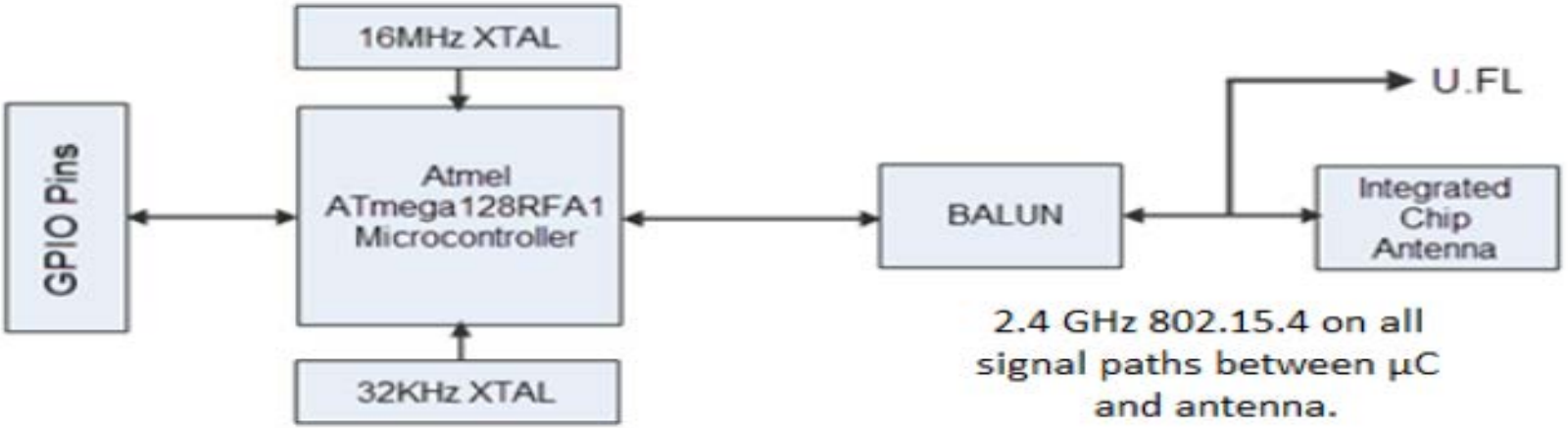
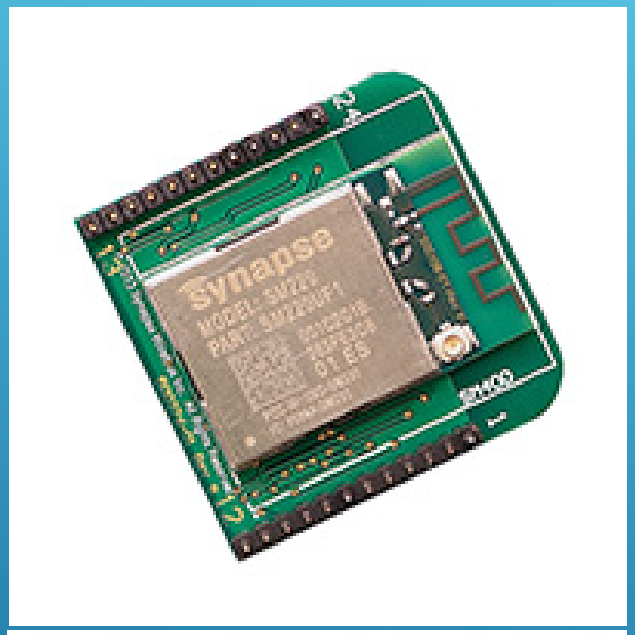
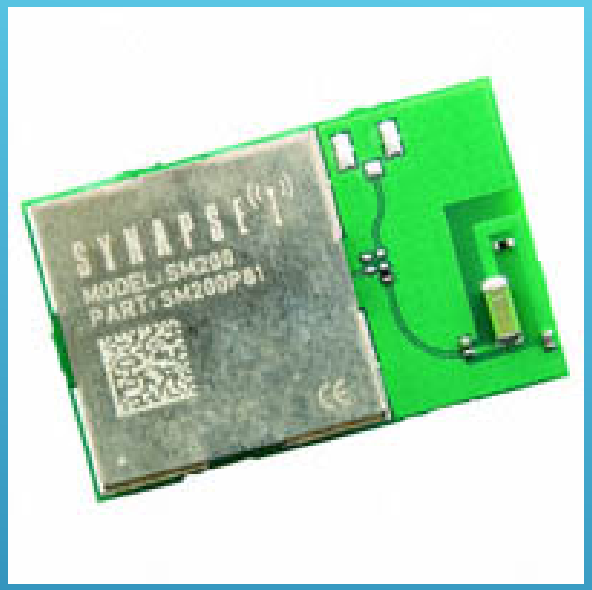
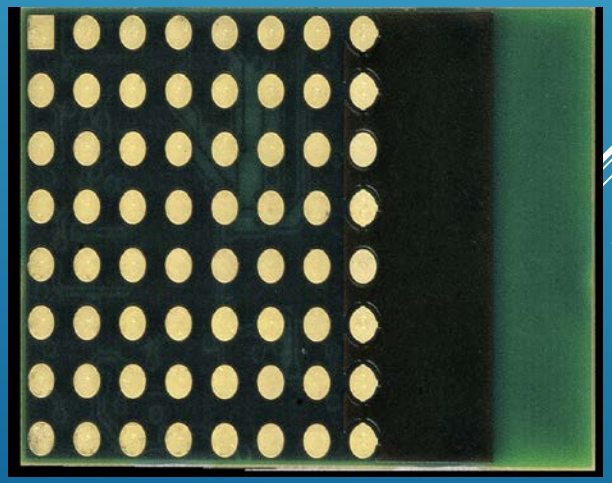


Table 1.0 Specifications		SM200P81/PU1	RF200P81/PU1
Performance	Outdoor LOS Range	Up to 1500/2500 feet at 250Kbps	
	Transmit Power Output	3 dBm	
	RF Data Rate	250Kbps, 500Kbps, 1Mbps, 2Mbps	
	Receiver Sensitivity	-100 dBm (1% PER, 250Kbps)	
Power Requirements	Supply Voltage	1.8 - 3.6 V	
	Transmit Current (Typ@3.3V)	22.5 mA	
	Idle/Receive Current (Typ@3.3V)	20.5 mA	
	Power-down Current (Typ@3.3V)	0.37 µA	
General	Frequency	ISM 2.4 GHz	
	Spreading Method	Direct Sequence (DSSS)	
	Modulation	O-QPSK	
	Dimensions	29.8mm x 19mm	33.86mm x 33.86mm
	Operating Temperature	- 40 to 85 deg C.	
	Antenna Options	Integrated Chip Antenna / External Antenna	
Networking	Topology	SNAP	
	Error Handling	Retries and acknowledgement	
	Number of Channels	16	
Available I/O	UARTS with HW Flow Control	2 Ports - 8 total I/O	
	GPIO	38 total; 7 can be analog-in with 10bit ADC	20 total; 7 can be analog-in with 10bit ADC
Agency Approvals	FCC Part 15.249	FCC ID: U9O-SM200	FCC ID: U9O-SM200
	Industry Canada (IC)	IC: 7084A-SM200	IC: 7084A-SM200
	CE Certified	Yes	Yes

WIRELESS SYNAPSE FOOTPRINTS







Generation 1

"Gen 1"

6 gauges all powered at same time.

Strain gauged excitation voltage is straight off main battery rail.

Op amp only has a 200 gain. This is a fixed gain set by on board resistor

No shunt or other method for onboard calibration.

No Power Management

Generation 2

Only 1 Gauge

- **Another version coming with 3 gauges for 3-dimensionl measurements**

Each strain gauge has an independent constant voltage regulator driving the excitation voltage

- **This provides solid voltages for more accurate measurements.**

Power Management Hardware,

- **The power for each gauge sub circuit can be turned on or off by software saving battery power.**

Op Amp has much larger and adjustable gains

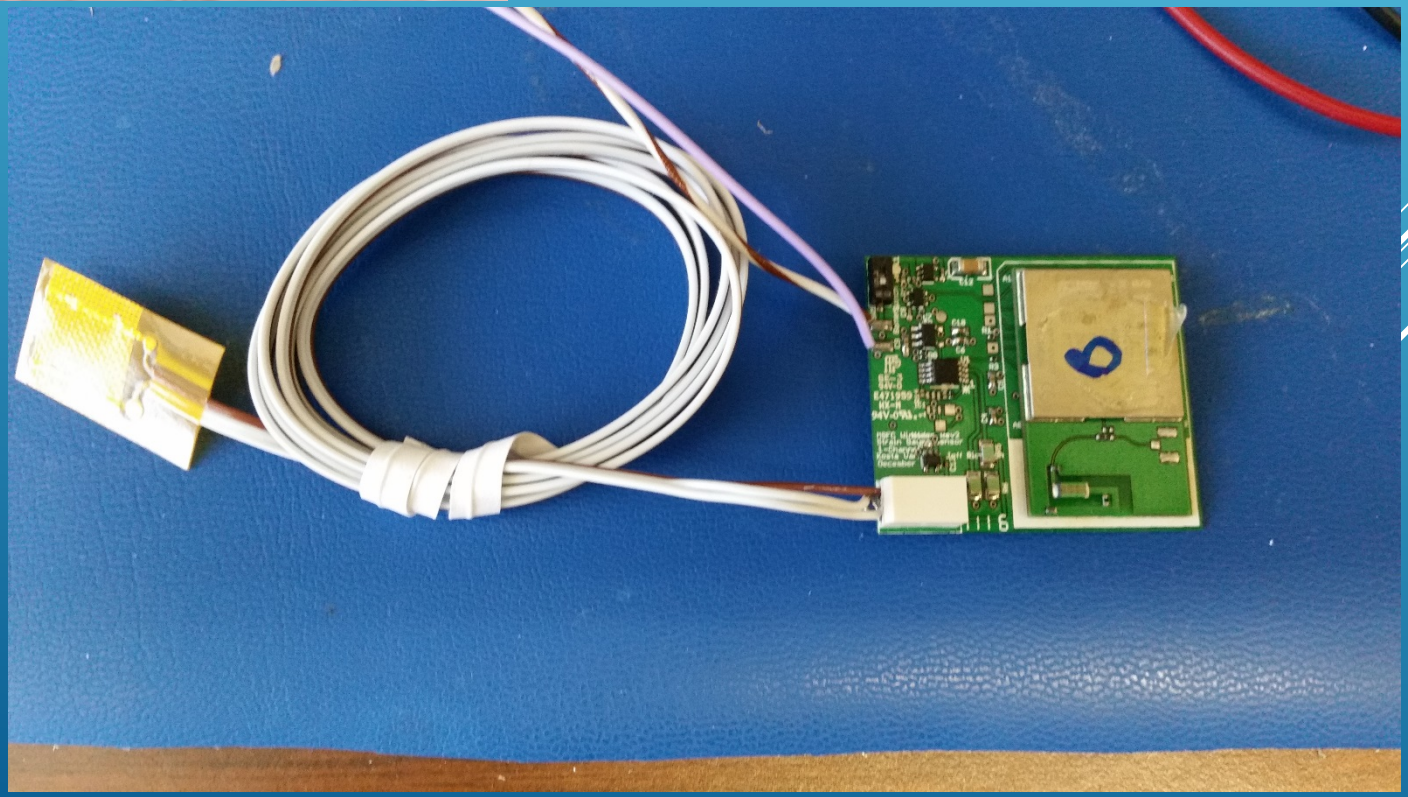
- **Gains up to 1000 and is variable under**
- **software control via digital potentiometer.**

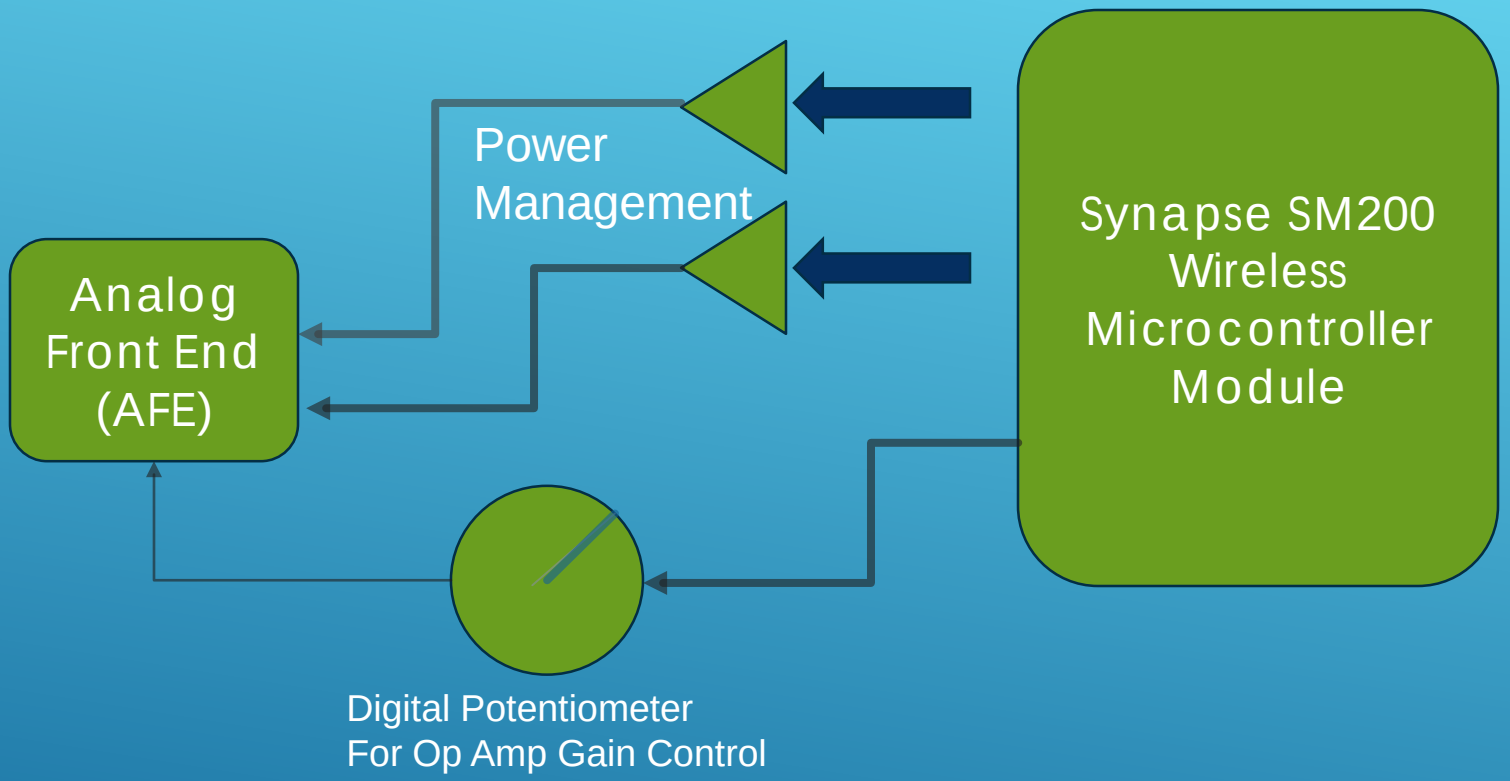
Power Management Software,

- **Software can control power management**
- **hardware to maximize battery life.**

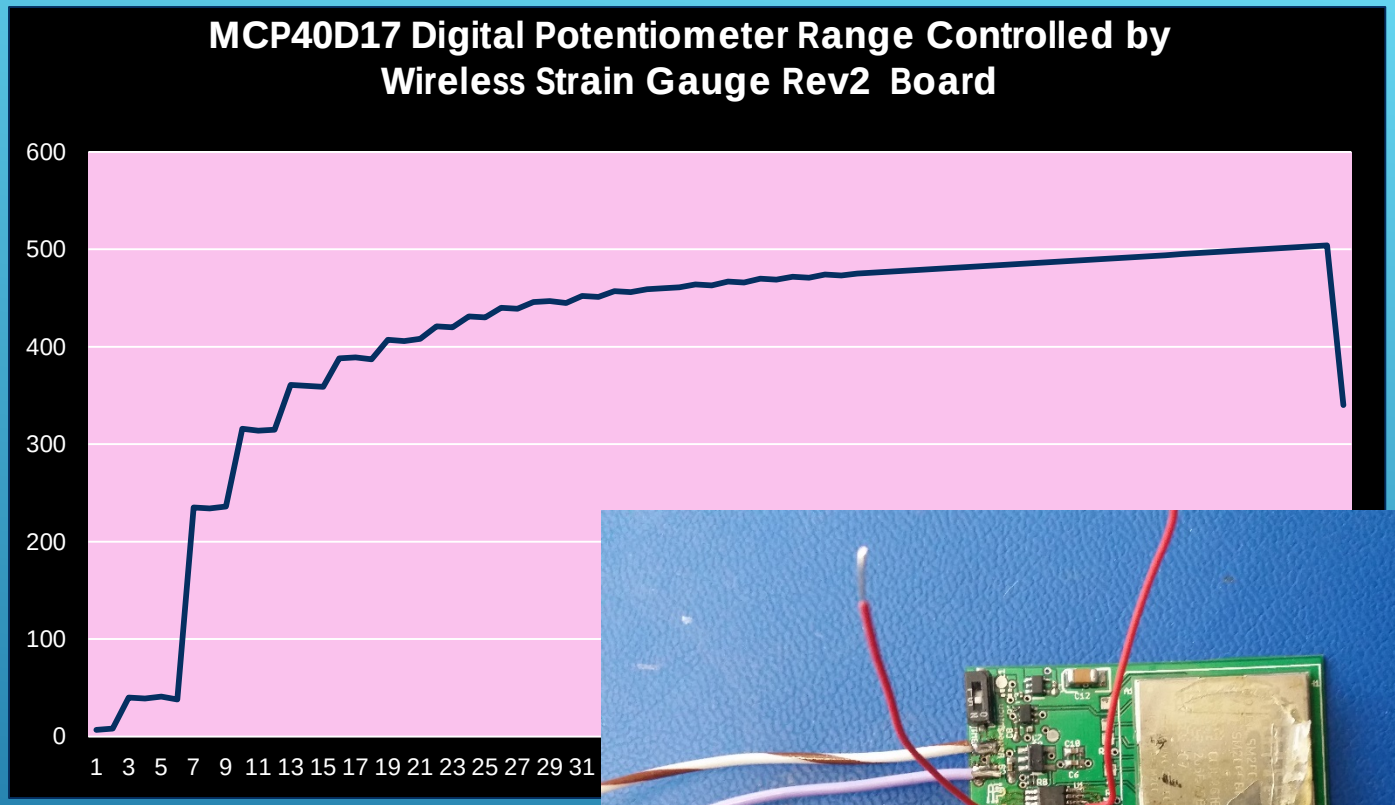
Gen 2 Wireless Strain Gauge
* 1 Channel
* With Battery
* 1.5 “ x 1.3 “ without case.

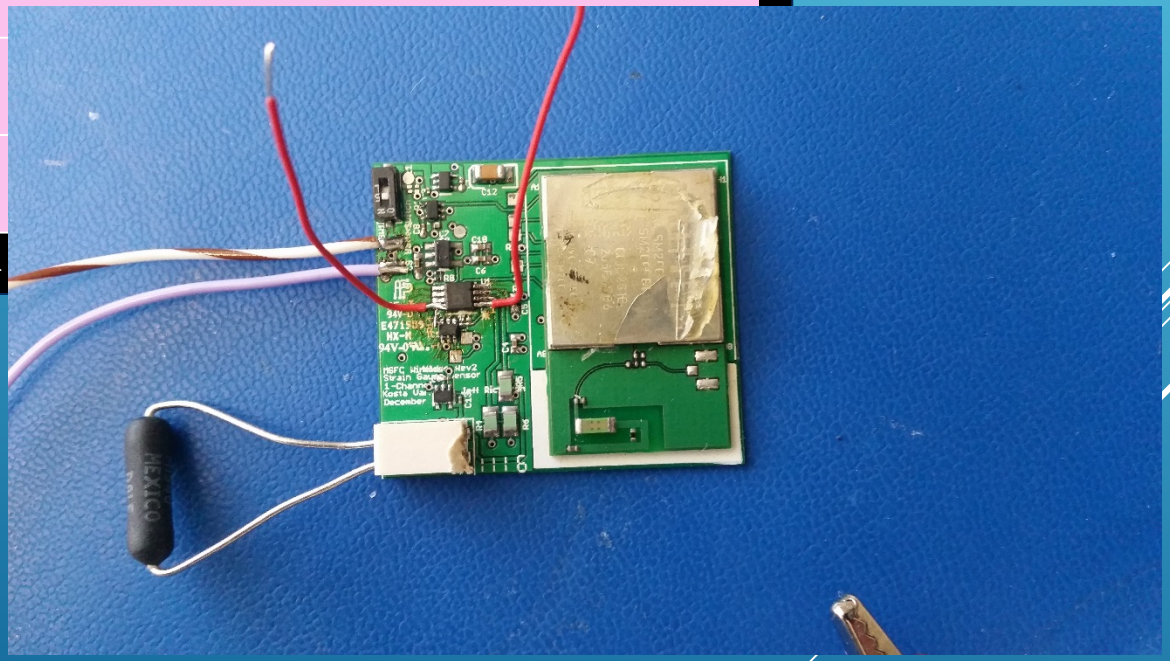
Gen 2 Wireless Strain Gauge with power leads And strain gauge Attached.





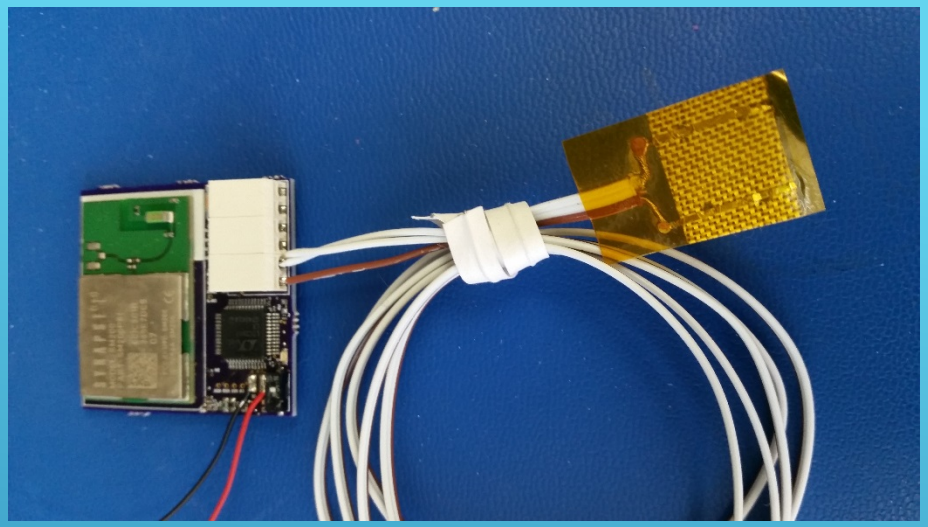
BLOCK DIAGRAM
WIRELESS STRAIN GAUGE





Test of op amp gain change using digital potentiometer and 350 ohm reference resistor.

Wireless Temp Board



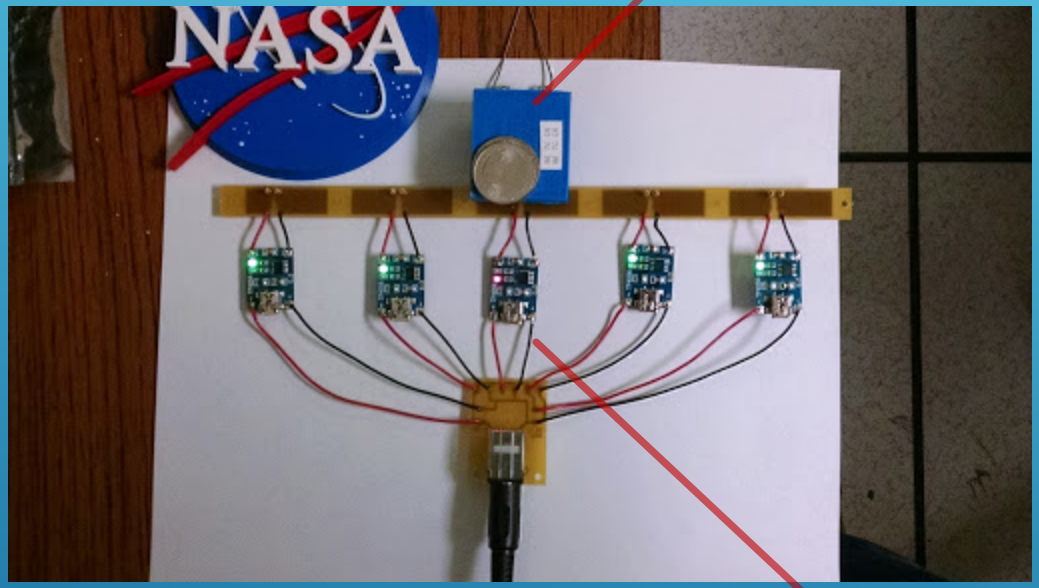
With RTD

Can measure :

- virtually all standard (type B, E, J, K, N, S, R, T) or custom thermocouples.
- Automatically compensate for cold junction temperatures and linearize the results.
- 2-, 3-, or 4-wire RTDs.
- Thermistors.
- Diodes.
- SPI bus controlled.

3-D printed (additive manufactured) casing for the 5-bay charging system was designed and created. Same as the blue housing for sensor node.

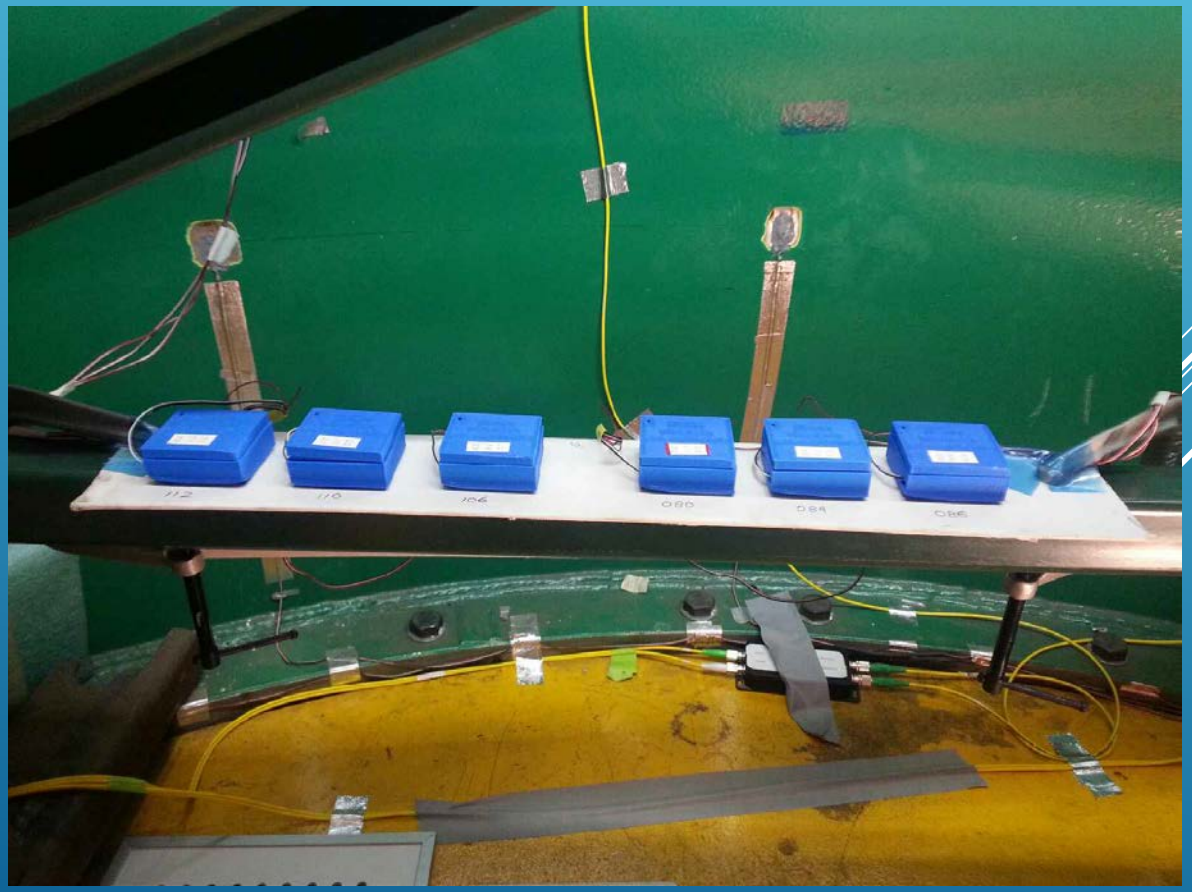
This is one wireless module on charging circuit. Charging bay has room for 5 modules.

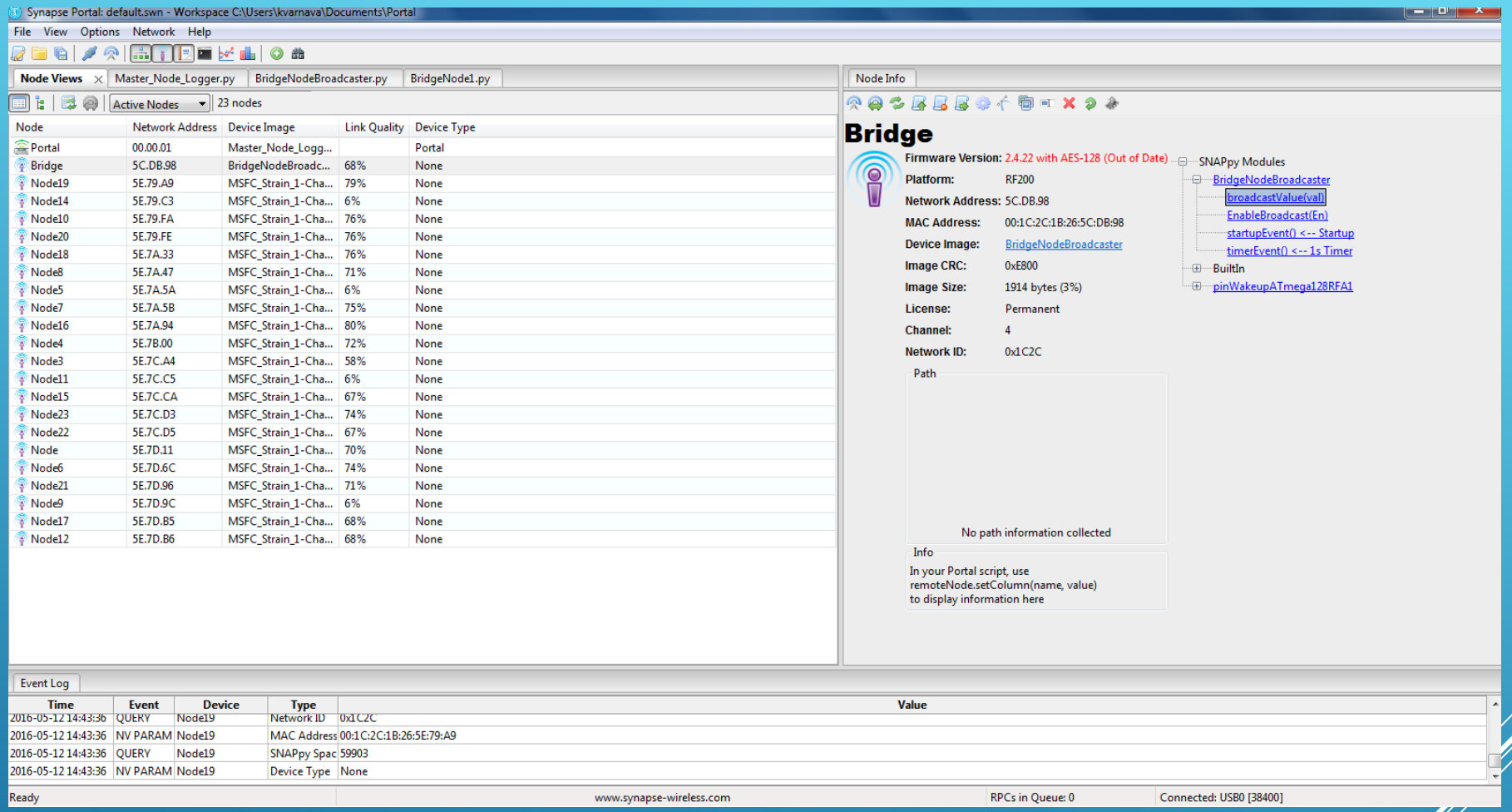


Commercial charging nodes , are specific for charging and preventing over charging of Li-ion batteries.

Composite Shell Buckling Test

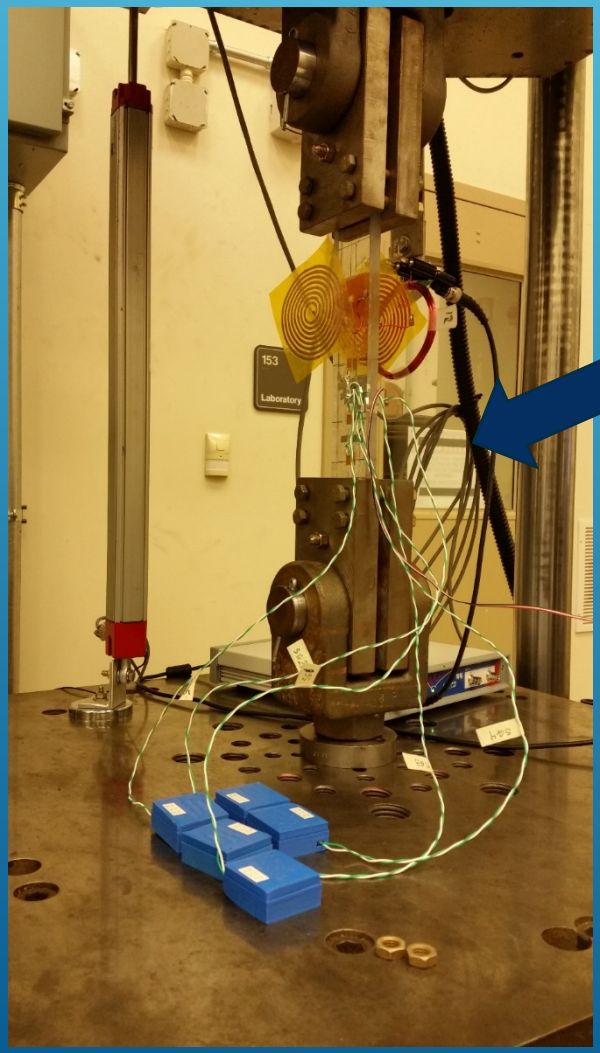
20 – 1 Channel MSFC Wireless Sensor inside Composite shell

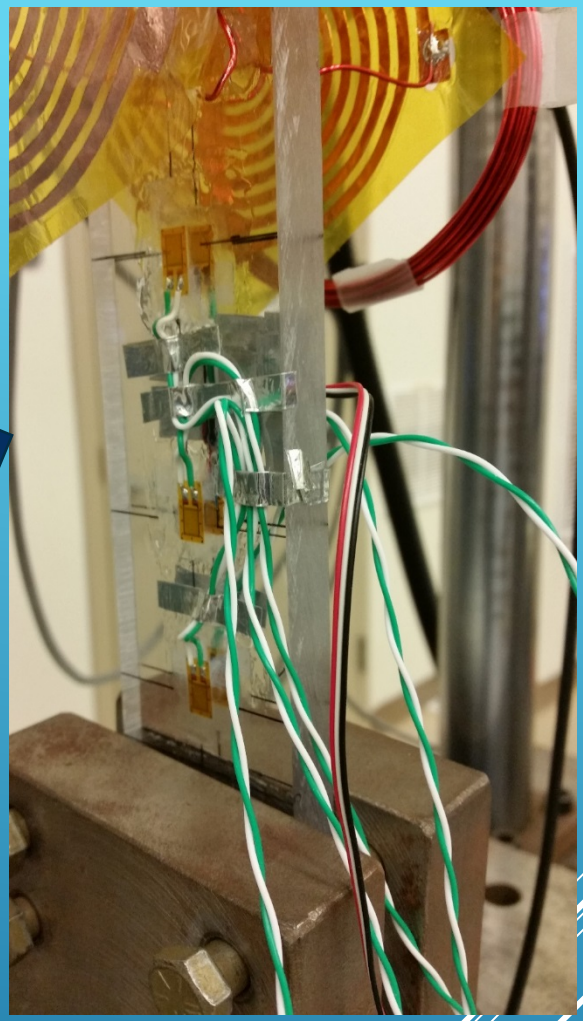




Control GUI – Large amount of interference caused all of the nodes to drop out shortly after test began. The test article was in a safety keep out zone so there was no way to fix or restart with fewer nodes after testing started.

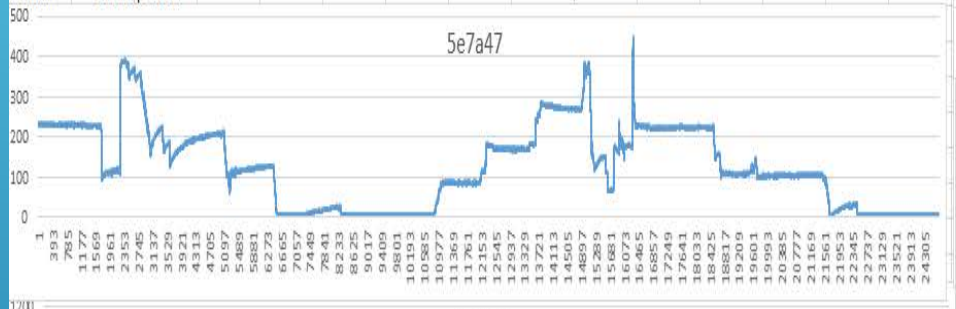
Test Lab Pull Test July 2016 Setup

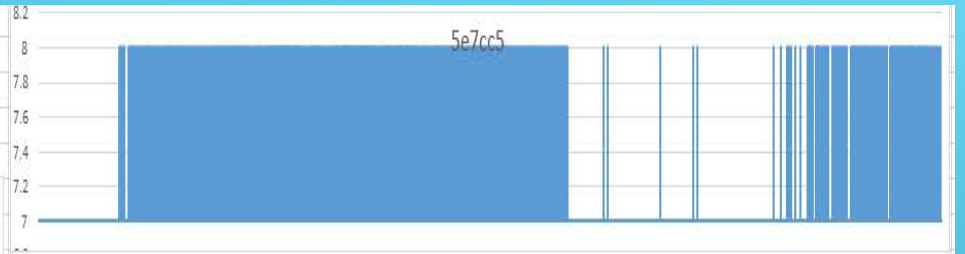


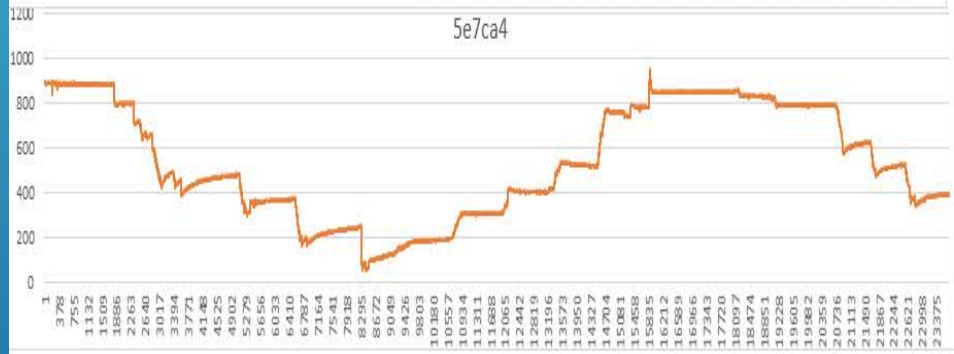


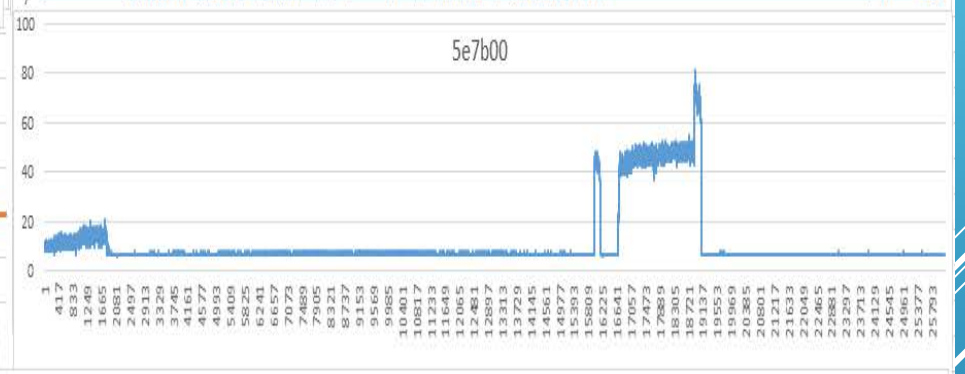
Test Lab Pull Test July 2016 Data Results

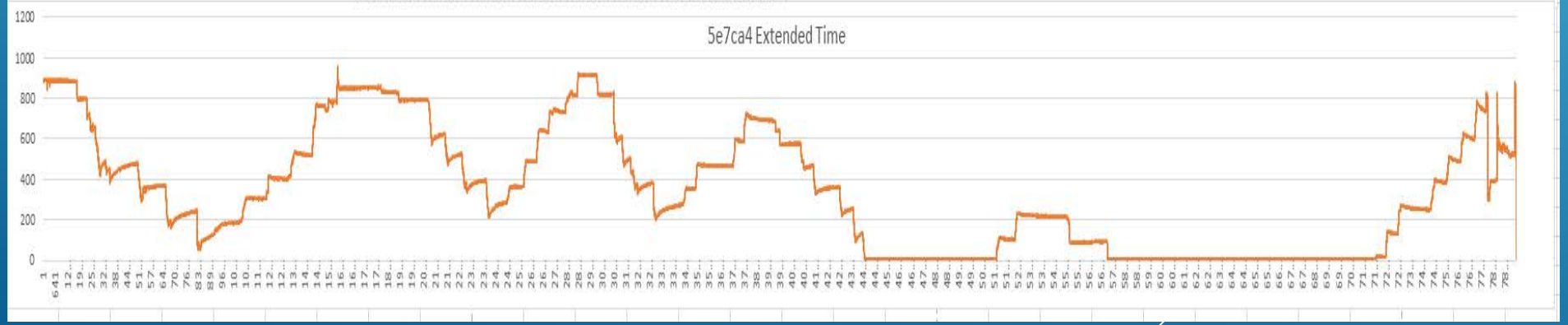
5e7b00	26175 packets
5e7ca4	79348 packets
5e7a5a	24553 packets
5e7cc5	26585 packets
5e7a47	24692 packets











Coming In Gen 3

Calibration shunt that can be switched in and out of circuit by software.

Advanced Software Controls

Better Battery and Power Management

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Back Up Charts